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| 09/603,118 | 06/22/2000 | Koichi Nitta | KYOW-900-(US) | 9026 |

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EXAMINER

LOUIE, WAI SING

| ART UNIT | PAPER NUMBER |
|----------|--------------|
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2814

DATE MAILED: 07/18/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Applicati n N .

09/603,118

Examiner

Wai-Sing Louie

Applicant(s)

NITTA ET AL.

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-32 is/are pending in the application.
- 4a) Of the above claim(s) 15, 16, 18, 19 and 28-32 is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-14, 17 and 20-27 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on ____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 5.

- 4) ☐ Interview Summary (PTO-413) Paper No(s). ____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Election/Restrictions

Restriction to one of the following inventions is required under 35 U.S.C. 121:

- I. Claims 1-14, 17, and 20-27, drawn to a semiconductor device, classified in class 257, subclass 79.
- II. Claims 15-16, 18-19, and 28-32, drawn to a method of manufacturing the device, classified in class 438, subclass 22.

The inventions are distinct, each from the other because of the following reasons:

Inventions Group I and Group II are related as process of making and product made. The inventions are distinct if either or both of the following can be shown: (1) that the process as claimed can be used to make other and materially different product or (2) that the product as claimed can be made by another and materially different process (MPEP § 806.05(f)). In the instant case, instead of forming the light-emitting structure on the buffer layer and partially removing the light-emitting structure, it would be possible to form the light-emitting structure on a handle substrate, removing the handle substrate, and then grow the rest of the layers.

Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.

During a telephone conversation with Edward Weller on 7/8/02 a provisional election was made without traverse to prosecute the invention of Group I, claims 1-14, 17, and 20-27.

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Affirmation of this election must be made by applicant in replying to this Office action.

Claim 15-16, 18-19, and 28-32 withdrawn from further consideration by the examiner, 37

CFR 1.142(b), as being drawn to a non-elected invention.

Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claim 26 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

- In claim 26, there is at least one light-emitting element and since there could be just one, it is not understood how different wavelengths could be emitted.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-2, and 9-12 are rejected under 35 U.S.C. 102(b) as being anticipated by Schetzina (US 5,351,255).

With regard to claim 1, Schetzina discloses a semiconductor light-emitting device (col. 9, line 9 to col. 24, line 8 and fig. 26) comprising:

- A substrate 103;
- A reflective layer 13 which is formed on the substrate, contains a metal, and reflects light (col. 19, lines 4-6);
- A light-emitting layer 101 formed on the reflective layer to emit light;
- A transparent electrode 102 formed the light-emitting layer.

With regard to claim 2, Schetzina discloses the light-emitting layer 101 has a double-heterostructure 11 in which an active layer 101 is sandwiched between first and second cladding layers 16 and 17 (fig. 26e).

With regard to claim 9, Schetzina discloses the transparent electrode 102 is formed of ITO (col. 18, lines 44-45).

With regard to claim 10, Schetzina discloses the substrate contains a metal (col. 19, lines 9-11).

With regard to claim 11, Schetzina discloses the first and second cladding layers 16 and 17 are set bandgap larger than a bandgap of the active layer 101 (fig. 16a and 17).

With regard to claim 12, Schetzina discloses the active layer 101 could be single or multiple quantum well structure including a well layer and a barrier layer (col. 18, lines 32-38 and fig. 16a-p).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 3-8 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schetzina (US 5,351,255) in view of Biing-Jye et al. (US 6,169,294).

With regard to claims 3 and 4, Schetzina discloses a semiconductor light-emitting device further comprising:

- An electrode 105 of one conductivity type between a surface of the substrate 103 and the reflective layer 13;
- A contact layer 18 of the one conductivity type between the reflective layer 13 and the light-emitting layer 101;
- Schetzina does not disclose a contact layer of an opposite conductivity type between the light-emitting layer 101 and the transparent electrode 102. However,

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Biing-Jye et al. disclose a light-emitting device having an n-GaN contact layer between the light-emitting layer and the n-type electrode (fig. 3). Biing-Jye et al. teach this layer serves as a nucleation layer (Biing-Jye col. 1, lines 32-33).

Therefore, it would have been obvious to one with ordinary skill in the art to provide a contact layer in order to have a nucleation layer.

With regard to claim 5, Schetzina modified by Biing-Jye et al. disclose an n-GaN ohmic contact layer in claim 4 above and an n-GaN layer sandwiched between the n-GaN ohmic contact layer and the n-AlGaIn cladding layer (fig. 3). Biing-Jye et al. do not disclose the n-GaN layer has a middle bandgap of the n-GaN ohmic contact layer and the cladding layer. However, the n-GaN layer provides at the same location and it must serve the same purpose.

With regard to claim 6, Schetzina discloses a Group II-VI light-emitting structure and Schetzina also discloses the structure could be made of Group III-V compound (col. 22, lines 26-33). Biing-Jye et al. disclose a similar light-emitting structure constructed by GaN Group III-V compound. Therefore, it would have been obvious to one with ordinary skill in the art to construct a light-emitting structure of GaP Group III-V compound including the InGaP or InAlGaP.

With regard to claim 7, Schetzina discloses an intermediate layer 106 between the electrode 104 and the reflective layer 13 (fig. 26e).

With regard to claim 8, Schetzina discloses the ohmic electrode 13 could be made of ITO, which is a transparent electrode (col. 12, lines 43-50). Schetzina also discloses a metal electrode 104, which is a metal layer (col. 19, lines 6-7). Therefore, the metal electrode 104 is reflective and two layers together is a two-layered reflective electrode.

With regard to claim 13, Schetzina modified by Biing-Jye et al. disclose the light-emitting device comprising:

- A transparent ZnSe semiconductor substrate 15;
- A light-emitting layer 101;
- Schetzina does not disclose a buffer layer that is lattice matched formed on the substrate. However, forming a buffer layer on the substrate is common in the art such as Biing-Jye et al. (Biing-Jye fig. 2a). Therefore, it is obvious to have a buffer layer on the substrate.
- Schetzina modified by Biing-Jye et al. disclose a first electrode formed on the buffer layer (Biing-Jye fig. 2a).
- Schetzina modified by Biing-Jye et al. disclose a second light-reflecting electrode formed on the light-emitting layer (Biing-Jye fig. 2a).

Claims 14 and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schetzina (US 5,351,255) in view of Takeuchi et al. (US 5,225,692).

With regard to claim 14, Schetzina discloses a semiconductor device comprising:

- A semiconductor substrate 15 (fig. 26a);
- A light-emitting layer formed on the semiconductor substrate 15;
- First and second electrodes formed on the same plane (fig. 26a), but Schetzina do not disclose the semiconductor substrate 15 has a light extraction window so as to pass light emitted by the light-emitting layer. However, it is common in the art to have a window on the substrate to minimize the light absorption by the substrate.

Example of such device is shown by Takeuchi et al. (Takeuchi fig. 4). Therefore, it would have been obvious to one with ordinary skill in the art to have a window on the substrate so as to pass light emitted by the light-emitting layer. Doing so could cut down the light absorbed by the substrate.

With regard to claim 25, in addition to limitation disclosed in claim 1-2 above, Schetzina also discloses:

- Schetzina does not disclose the substrate has a rounded edge. However, Schetzina, modified by Takeuchi et al. in claim 14 above, disclose the LED having a window 10a, which has a rounded edge (Takeuchi fig. 4).

Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Schetzina (US 5,351,255) modified by Biing-Jye et al. (US 6,169,294) as applied to claim 3 above, and further in view of Takahashi et al. (US 5,360,762).

With regard to claim 17, in addition to the limitation disclosed in claims 1-14 above, Schetzina modified by Biing-Jye et al. also disclose:

- Schetzina modified by Biing-Jye et al. discloses a contact layer formed on the double-heterostructure, but do not disclose a recessed surface on the contact layer. However, Takahashi et al. disclose a light-emitting device having a groove (recess) formed in the double-heterostructure and the cap (contact) layer 42 forms a recess (Takahashi fig. 6d). Takahashi et al. teach the recess can reduce the optical absorption loss and have a low threshold current. Therefore, it would have

been obvious to one with ordinary skill in the art to have a recess in the heterostructure in order to reduce the optical absorption loss and have a low threshold current.

Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Schetzina (US 5,351,255) in view of Bour et al. (US 5,977,612).

With regard to claim 20, Schetzina does not disclose the shape of the light-emitting device is a polygonal prism having at least five corners or a circular cylinder. However, Bour et al. disclose a cylindrical LED on a hexagonal crystallite structure 200 (Bour fig. 2b). Bour et al. teach the conventional LED structures require a separation between LED structures (Bour col. 2, lines 1-4), but an array of crystallites could be formed in a single substrate (Bour col. 3, lines 1-15) by taking advantage of the natural lattice structure of III-V compound (Bour col. 2, line 48-60). Therefore, it would have been obvious to one with ordinary skill in the art to have a hexagonal or cylindrical light-emitting structure in order to form a high-density integrated device.

Claims 21-23 and 26-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schetzina (US 5,351,255) in view of Suzuki et al. (US 5,253,264).

With regard to claims 21 and 22, Schetzina does not disclose a photonic crystal layer on at least one surface of the light-emitting layer. However, Suzuki et al. disclose an integrated LED device having a diffraction grating formed on the uppermost InGaAsP layer 3b of the multiple quantum well (Suzuki col. 15, lines 34-39 and fig. 4). Suzuki et al. teach the LED device would

integrate with other optical semiconductor device to form a photonic integrated circuit (Suzuki col. 14, line 66 to col. 15, line 10). Therefore, it would have been obvious to one with ordinary skill in the art to include the diffraction grating in the photonic crystal layer 3b in order to form an integrated optical semiconductor device. Suzuki et al. do not disclose which direction the diffraction grating is formed. However, one with ordinary skill in the art could form the photonic element in same direction of the light-emitting layer or opposite direction.

With regard to claim 23, Schetzina does not disclose a photonic crystal layer is formed on the light-emitting layer and a through dislocation exists on a light extraction surface in a vertical direction to pass light emitted by the light-emitting layer. However, Suzuki et al. disclose a dislocation occurred near the side surface of the active layer 4 (Suzuki col. 2, lines 51-60). Therefore, it is obvious to form the diffractive grating in the dislocation defect of the active layer.

With regard to claims 26 and 27, in addition to limitation disclosed in claim 1-2 and 21-23 above, Schetzina also discloses:

- Schetzina modified by Suzuki et al. disclose at least one light-emitting layer formed on each of the two surface of the diffraction grating (Suzuki col. 23, lines 18-40 and fig. 14 and 15). The wavelength is 1.52-1.57 μm (Suzuki col. 23, lines 54-65).
- Schetzina modified by Suzuki et al. disclose a Bragg reflective layer could be formed (Suzuki col. 14, lines 56-65).

Claim 24 is rejected under 35 U.S.C. 103(a) as being unpatentable over Schetzina (US 5,351,255) in view of Paoli et al. (US 5,138,625).

With regard to claim 24, in addition to limitation disclosed in claim 1-2, 14, and 17 above, Schetzina also discloses:


- Schetzina does not disclose an interface of the contact layer in contact with the first cladding layer is corrugated to have a gradient index and light emitted by the light-emitting layer is reflected by the interface. However, Paoli et al. disclose a LED having a corrugated interface between the contact layer 300 and cladding layer 296 (Paoli col. 12, lines 7-41 and fig. 12). Paoli et al. teach the V-groove of the corrugated interface polarizes the light beam parallel to the plane of incidence (Paoli col. 6, lines 1-9 and col. 12, lines 1-18). Therefore, it would have been obvious to one with ordinary skill in the art to provide a corrugated interface between the contact layer and cladding layer. Doing so would control the polarization of the light emission.⁴

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Wai-Sing Louie whose telephone number is (703) 305-0474. The examiner can normally be reached on 7:30 AM to 4:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on (703) 306-2794. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7722 for After Final communications.

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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.



Douglas A. Wille
Patent Examiner

wsl

July 15, 2002

